ABSTRACT: A self-contained high-expansion foam fire extinguishing system providing an independent source of pressurization to a container holding a mixture of water and foam concentrate for delivery to a foam generator having a plurality of nozzle members and a screen to produce high-expansion foam upon activation of the system by a fire detecting sensor.
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SELF-CONTAINED FOAM FIRE EXTINGUISHING SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a new type of foam fire extinguishing system of the type having a storage tank for foam producing matter. A foam generator for producing foam, said system especially adapted for installation in a store or other buildings.

2. Prior Art

A self-contained efficient and highly reliable high-expansion foam system for the extinguishing of a fire in a building has long been a desired goal. High-expansion foam is a relatively new development for fighting fires, especially in buildings. The prior art discloses some high-expansion foam fire fighting systems, both portable and fixed installations. For purposes of this invention, the term "high-expansion foam" will be understood to define a foam which expands a given volume of water together with a concentrated mix (in solution) from 300 to 1,500 times its original volume.

SUMMARY OF THE INVENTION

The basic problem to be solved by the invention is to provide a high-expansion foam generating system to be used as a fire fighting system, and which is completely independent of external conditions.

The high-expansion foam fire extinguishing system utilizes a premixed high-expansion foam concentrate. When a sensor detects the presence of a fire, a valve is opened, placing the high-expansion foam concentrate under pressure from gaseous nitrogen. Placing the high-expansion foam concentrate under pressure forces the concentrated mixture into a manifold having a plurality of attached nozzles. When the concentrated mixture is forced through the nozzle, a cone of liquid concentrate is emitted.

The cone of liquid concentrate is emitted into a foam generator defined by an upper wall, a bottom wall, a pair of sidewalls and a screen. The top wall extends from the inner wall of the building to a point beyond the nozzles. The top wall may extend beyond the intermediate wall within the building to a point beyond the nozzles. By this method foam generators can be placed back to back with the intermediate wall dividing the foam generators. The screen is attached between the upper wall and the bottom wall. It is placed at a specific angle to the cone of emitted concentrate. The bottom wall extends from the screen to a point substantially in the vicinity of the nozzles.

The foam is formed by a combination of air and high-expansion foam concentrate striking the screen. Air is drawn through the space defined by the lower wall of the foam generator and the inner wall of the building. The air heated by the fire can only enter the foam generator at this point because the upper wall fully covers the nozzle output.

The screen is a steel or other fire-resistant medium which has a plurality of holes. The ratio of hole area to the total area of the screen is an important factor in creating the foam. The solid area of the screen is coated with hammertone or crackle paint. The cracks in the paint create the agitation necessary to create the foam. The nozzles are spaced along the manifold at a predetermined distance that is necessary to ensure full coverage of the screen surface. Since the cones formed by emitted concentrate fully cover the screen, the system constitutes a linear generator in that an even distribution of foam is created along the entire length of the foam generator.

The foam emitted from the screen is directed downward because of the angle of the screen. The heated air is drawn through the foam cooling the air. The foam will continue to be generated cooling the entire area of the building. Since the foam has a high-water content, the fire will be extinguished. The high-expansion foam concentrate contains a detergent which acts to clean the inner areas of the buildings as well as extinguish the fire.

It is therefore an object of the invention to provide a fire fighting system which is independent of external water supplies, pressurization and electric power.

It is a further object of the invention to provide a fire fighting system which utilizes a high-expansion foam concentrate.

It is still a further object of the invention to provide a foam generator without the use of motors fans or other air moving devices.

A still further object of the invention is to provide a linear foam generator.

DESCRIPTION OF THE DRAWINGS

These and other objects will be more readily understood by reference to the following description in claims taken in conjunction with the accompanying drawings forming a part hereof.

IN THE DRAWINGS:

FIG. 1 is a partial sectional view showing the presently preferred embodiment of this invention installed within a building and the manner in which it is employed to extinguish a fire which may have occurred within the building;

FIG. 2 is an enlarged cross-sectional view showing the foam generator portion of FIG. 1 enlarged in size;

FIG. 3 is an enlarged perspective view of the generator of FIG. 1;

FIG. 4 is a plan fragmentary view of the screen forming part of the generator of FIG. 3;

FIG. 5 is a view taken along lines 5-5 of FIG. 4;

FIG. 6 is an enlarged sectional view of an exemplary nozzle as may best be seen in FIG. 3 forming part of the generator; and

FIG. 7 is a schematic view showing the discharge cone of the fluid solution as it exits from one of the nozzles forming part of the generator of the present invention system.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference is now made to FIG. 1, wherein the presently preferred embodiment of this invention is shown installed within a storage building generally numbered 10. The foam generator is generally designated by the numeral 50 as shown extended from the ceiling or roof of the building by cables or chain 53. The exterior wall of the storage building 10 is numbered 14 and the interior wall 15. The ground of the floor of the building is numbered 16. The present invention foam system is self-contained and requires not external source of electric power, hydraulic power or gas power. Included within the system, in order to generate foam upon the occurrence of a fire within a building 10 there is provided a source of nitrogen under pressure shown within a container 22. Container 22 is connected through an appropriate line 36 to a valve-pressure regulator 34 to a concentrate mix solution tank 24. A line 40 exits from tank 24 and connects to a manifold 44 through an opening 42 in the wall 16. As may best be seen in FIG. 2, the upper wall 52 of the foam generator 50 extends to and abuts against the interior wall 16 of the building, while the lower wall 53 of the generator extends from the vicinity of the manifold 44 forward to an inclined screen which joins to the upper and lower walls 52 and 54 of the foam generator. The rear portion of wall 54 does not extend to or abut against the wall 16 of the building as does the upper wall 52 of the foam generator.

The foam system is activated when sensor 26 detects the presence of a fire. Sensor 26 is a heat detector which initiates an alarm upon detecting an ambient temperature of 135° F. Sensor 26 is a conventional heat detector of the type manufactured by the Walter Kidde Corporation. The output of sensor 26 appears on line 28 and energizes a relay pack 30 which produces an electrical signal on lines 32 to the valve-pressure...
3 regulator 34. Valve-pressure regulator 34 is an electrically activated device regulating the pressure to be imposed upon the concentrate mix solution tank 24. The valve-pressure regulator 34 can be set for outlet pressures of approximately 70, 80, or 90 p.s.i. Preferable testing conditions require the valve-pressure regulator to produce a flow rate of 65.8±1.0 standard cubic feet per minute for 80 gallon per minute delivery at 90±1 p.s.i. The valve-pressure regulator 34 is manufactured by Accessory Products Corporation, Whittier, California, a division of Extem Industries and is designated as APCO No. 803500D-3. By opening valve-pressure regulator 34 the gaseous contents of container 22 flows through line 36, pressure regulator 34, line 38 and into the concentrate mix solution tank 24. Since the concentrate mix in container tank 24 is under pressure, the mixture is forced into line 40.

The high-expansion foam concentrate is, by weight composed to 3.0 to 4.5 percent Neodol 25, 30 to 35 percent Neodol 23-3A, 26 to 30 percent butyl oxial and the balance of 30.5 to 41 percent of water. The concentrate is further diluted by volume to a concentration of 3 percent of the above foam concentrate and 97.0 percent water. Neodol 23-3A is defined in "Shell Chemical Bulletin, I. C. 6741" and is an aqueous solution of ammonium salt of a sulfated primary alcohol ethyloxylate containing on the average three ethylene oxide units. Neodol 23-3A can be characterized by a molecular weight of approximately 423, a concentrate of ethylene oxide by weight of 31.2 percent, a specific gravity at 25°C of 1.010 and a pH of 7.3. It is a light colored viscous liquid containing about 60 percent by weight surfactant and ethanol is included as a solubilizer Neodol 25 is commercially available from the Shell Chemical Company. Neodol 25 designates an alcohol blend characterized by the symbol R-OH where R is a blend of linear primary alcohols with 12, 13, 14 and 15 carbon atoms. The physical characteristics of Neodol 25 are a molecular weight of approximately 207, a specific gravity at 25°C of 0.834, and a viscosity of 18.3 centipoise at 100°F. A high-expansion foam is distinguishable from low-expansion foam concentrate by the expansion ratio which is defined by the volume of foam produced divided by the original volume of the concentrate. A high-expansion concentrate has an expansion ratio of 500 to 1,500 while a low expansion concentrate has an expansion ratio of 10 to 20. The preferable ratio for use in buildings is 650 to 700. The expansion ratio can be changed by changing the concentrate mixture. Referring to FIG. 1, the valve-pressure regulator 34 can be set for a pressure of 70, 80, or 90 p.s.i. When the pressure is applied to the concentrate mix solution tank 24, the concentrate will have an expansion ratio of 600, 700, or 800, respectively. The amount of concentrate available for fire fighting can be increased by putting a plurality of solution tanks 24 in series. Referring to FIG. 1a, in which an alternate form for the source subsystem 20 is shown, three solution tanks 24 are serially connected with the result approximately three times more foam can be produced. By putting a plurality of source subsystem 20 in parallel, the volume per unit of time of foam generated can be increased.

Referring to FIG. 2, the concentrate is forced into line 40 and into manifold 44 with a resulting emission of concentrate at nozzle 60. The nozzle 60 can be attached to the manifold 44 in any suitable manner but preferably by a threaded joint 62 as shown in FIG. 6. The nozzle 60 can have a spiral chamber 64 leading to an annular flanged output 66 which will produce an output emission forming a cone. The nozzle 60 separation along manifold 44 can be best seen in FIG. 3. The concentrate cone 68 emitted by a nozzle 60 is such that all parts of the screen 56 should be reached by the concentrate. If the nozzle 60 are spaced 9 inches apart, nitrogen pressure of 80 p.s.i. will produce 200 cubic feet of foam per minute per foot of generator. If the nozzle 60 separation is only 3 inches, the foam generated will equal 600 cubic feet per minute per foot of generator. The surface area created by the concentrate coming 68 is intersected by the foam generating screen 56. The screen 56 is attached to the lower wall 54 of the foam generator at an angle of 30° to 35° to flow axis.

The concentrate cone 68 strikes the foam generating screen 56. The screen 56 is a steel or other fire-resistant material into which a plurality of holes 58 are formed. The holes 58 in screen 56 should be three-sixteenth inches in diameter with the hole centers four inches apart. Preferably, the number of holes required is such that approximately 42 percent of the screen area is porous. The figure 42 percent will insure a sufficient flow of foam. The solid surface of the screen is covered with hartm Ottone or crinkle paint 78. This is best shown in FIG. 4. The hartmottone or crinkle paint 78 has a characteristics cracking which creates areas of extreme agitation necessary to generate foam from the concentrate. The thickness from the paint 78 must be less than one thousandth of an inch thick. This is shown in FIG. 5.

The rough cracked surface of paint 78 covers all solid surfaces of the foam generating screen 56 with the result that in and around the holes 58, foam generation is caused.

Referring to FIG. 2, the foam generated at screen 56 falls from screen 56 in a downward direction because of the angle created by screen 56 and the lower wall 54. The flow of foam will create a pile of foam 70 through which the heated air 74 is blown. The foam cone 68 of concentrate will create a partial vacuum thereby causing movement of the heated air 74 through the foam pile 70. Because the upper wall 52 shrouds the nozzle 60, the only part of air entry is area 72. By drawing the heated air 74, through the foam pile 70, the heated air 74 is cooled. The heated air 74 will carry particles emanating from the burn area 76 and in this turn, will partially contaminate the cone 68 of concentrate. This is best shown in FIG. 7. The outer surface or skin of the cone 68 of concentrate will be impregnated with the contamination particles but so long as the velocity of the concentrate is sufficient to prevent total impregnation of the cone 68, foam generation at the screen 56 will be effective.

Although this invention has been disclosed and illustrated with reference to particular applications, the principles involved are susceptible of numerous other which will be apparent to persons skilled in the art. The invention is, therefore, to be limited only as indicated by the scope of the appended claims.

What I claim is:

1. An improved fire extinguishing system of the type employing high-expansion foam, the improvement comprising:
   a. a reservoir containing a premixed, high-expansion fluid;
   b. a foam generator including:
      1. a plurality of nozzle members coupled to said reservoir;
      2. a screen disposed opposite said nozzles, said foam generator having top, bottom and side enclosures, said bottom enclosure extending from said screen to a distance substantially in the vicinity of said nozzles and said top enclosure extending from said screen substantially beyond said nozzles whereby air is drawn into said foam generator through an opening defined by said enclosures when fluid is caused to be discharged through said nozzles for projection upon said screen where said high-expansion foam is generated.

2. The fire extinguishing system defined in claim 1, wherein said screen is disposed at an angle relative to said streams of fluid discharged by said nozzles.

3. The fire extinguishing system defined in claim 1, wherein said screen has disposed over the exterior surfaces thereof a thin coating of hartmottone or crinkle paint.

4. The fire extinguishing system as in claim 2 wherein said angle is an acute angle.

5. The fire extinguishing system defined in claim 4, wherein said angle is in the range from 25° to 35°.

6. A fire extinguishing system of the type using high-expansion foam comprising:
   a. self-contained source means for containing pressurized gas;
   b. reservoir means coupled to said self-contained source means wherein said reservoir means contains a premixed high-expansion foam producing concentrate;
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5. foam generating means for drawing air into same and generating foam coupled to said reservoir means, said foam generating means comprising:

1. manifold means for distributing the high-expansion foam concentrate, said manifold means having spaced openings therein;
2. a plurality of nozzle means coupled to said spaced openings in said manifold means, said nozzle means outputting foam concentrate;
3. screen means for generating foam when struck by the foam concentrate; and
4. enclosure means for defining an opening through which ambient air is drawn by the output of said foam concentrate.

7. A system as in claim 6 wherein said pressurized gas is an inert gas.

8. A fire extinguishing system using a high-expansion foam concentrate as in claim 6 wherein said screen means has a plurality of holes therein and is covered with a layer of paint means for generating foam which forms a rough cracked surface on said screen means.

9. A system as in claim 8 wherein said holes in said foam generating screen means are three sixteenth inch in diameter and the distance between the centerlines of the holes is one fourth inch.

10. The system as in claim 8 wherein the hole area constitutes less than half of the total surface area of the foam generating screen.

11. The system as in claim 8 wherein the paint means is less than one one-thousandth inch thick.